ART 34 AMDT

PTO/PCT Rec'd 23 JUN 2000

09/582278

CAMERA MOUNTINGS FOR TV/VIDEO CAMERAS

This invention relates to camera mountings for TV/video cameras and is particularly although not exclusively applicable to the camera mountings of our European Patent Publication No. 0725758 and our UK Patent Publication No. 2163720.

WO/A-94/12424 discloses a counterbalanced load carrier comprising a multi-stage telescopic arm. One stage adjacent one end of the arm is mounted for rotation by a vertical axis on a mobile base. The adjacent end stage of the arm carries a counterweight and the end stage at the other end of the arm carries a support for a TV or video camera. The respective stages of the arm are interconnected by a cable or like mechanism to extend and retract together maintaining a fixed ratio between the radius of the payload support and the horizontal axis and the counterweight and the horizontal axis so that the arm remains counterbalanced throughout its range of extension and retraction. The cable mechanism also acts on the camera support on said end section of the arm to maintain the support horizontal throughout the range of tilting of the arm. An additional counterbalancing force can be applied at control point on end stage, the control point being constrained to move in a vertical guideway located on a horizontal moveable carriage to follow the vertical/horizontal movement of the end stage of the arm.

FR-A-2264298 discloses a camera mounting for movement of a camera in third orthogonal axes by steered wheels of a carriage, a pivot arm about a horizontal axis and a camera platform which pivots about a vertical and a horizontal axis. Each movement is monitored by a separate sensor to determine, with

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the aid of a computer, the position of the camera with respect to a reference point.

This invention provides a camera mounting for a TV-video camera, comprising a base, a counter-balanced arm assembly pivotally mounted on the base at one end thereof to swivel about a vertical axis and having a platform for carrying a camera at the other end thereof, the arm assembly having relatively movable components to permit, with said swivelling of the assembly about said vertical axis, movement of the platform in three orthogonal axes; wherein the base of the mounting has a datum point, the mounting has three separate transducer means for determining swivel movement of the arm about said vertical axis and relative movement between said arm components in a plane containing said vertical axis, and monitoring means are provided for determining, from the movements detected by said transducers, the position of the camera platform with respect to the datum point in said three axes to provide information regarding the location of the camera for purposes such as controlling movement of a virtual reality image to be combined with a real image as seen by the camera as the camera is moved with respect to the datum.

More specifically, the arm assembly is mounted on the base for rotation about a vertical axis through the datum point, the arm assembly providing movement of the camera platform in two orthogonal axes in any plane containing said vertical axis, and said transducer means comprising first means for determining rotation of the arm about said vertical axis and further means for determining movement of the camera mounting in said plane with respect to the datum point.

In one arrangement according to the invention

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the arm assembly may be telescopic and may be mounted on the base to pivot in a vertical plane about a horizontal axis.

In an alternative construction according to the invention, the arm assembly may comprise a first arm pivotally mounted on the base about a horizontal axis and a second arm pivotally mounted on the first arm about a parallel horizontal axis for supporting the camera platform.

In any of the above arrangements, the arm assembly may have a control point connected to the arm assembly so that movement of the control point with respect to the datum point in the vertical plane containing the arm and said vertical axis is directly proportional to the movement of the camera platform and said further transducer means is arranged to monitor movement of the control point with respect to the datum point.

More specifically, the transducer means for monitoring movement of the control point may comprise separate transducers for responding to movement of the control point with respect to the datum point in vertical and horizontal directions.

In the case where the arm assembly is telescopically extendable and pivotable about a horizontal axis, the transducer means may be arranged to monitor extension of the arm and pivotal movement of the arm about said horizontal axis to monitor the position of the camera platform in a vertical plane with respect to said datum.

In the case where the arm assembly has first and second pivoted arms, said further transducer means may

be arranged to monitor pivotal movement of the first arm about said horizontal axis with respect to the base and pivotal movement of the second arm with respect to the first arm to monitor the position of the camera platform with respect to said datum.

The following is a description of some specific embodiments of the invention, reference being made to the accompanying drawings in which:

Figure 1 is a diagrammatic view of a camera mounting for a TV/video camera embodying a telescopic arm mounting and one arrangement of transducers for determining movement of the camera platform;

Figure 2 is a view of a similar camera mounting embodying a telescopic arm mounting with an alternative arrangement of transducers for determining movement of the camera platform;

Figure 3 is a diagrammatic view of a camera mounting having a pantograph arm assembly and arrangement of transducers for determining movement of the camera platform; and

Figure 4 is a similar view to Figure 3 showing a further arrangement of transducers for determining the movement of the camera platform.

Referring firstly to Figure 1 of the drawings, there is shown a camera mounting for a television or video camera. A detailed description of the arm is set out in our European Patent Publication No. 0725758 to which reference should be made. Briefly the mounting comprises a counter-balanced telescopic arm indicated generally at 10, mounted on a base indicated generally at 11. An upwardly extending bifurcated column 12 is mounted for rotation on the base about a vertically extending axis A-B. The bifurcated column has spaced arms 13 having inwardly extending trunnions 14

at their upper ends to receive and support the arm 10 for tilting about a horizontal axis indicated at C.

The telescopic arm comprises six elements or stages 15 to 20 which are slidably engaged one within the other to move between the extended position shown in Figure 1 and a retracted position which is not shown. A mechanism interlinks the successive stages of the arm so that when the arm is extended all the stages extend by the same amounts with respect to each other and when contracted, contract by the same amounts with respect to each other. The arm is pivotally mounted on the trunnion 14 on the intermediate element 16 next to end element 15 for rotation of the arm about the horizontal axis C defined by the trunnions.

The outer end stage 20 of the arm carries a platform 21 to receive and support a TV or video camera in a mounting which provides usual pan and tilt movements. The other end stage 15 of the arm contains a fixed weight (not shown) intended to balance the arm whether in extended or "telescoped" mode. The mounting thus permits manual (or "motorised") movement of the platform (and thereby the camera) in three axes with respect to an origin or datum point on the base and also normal pan and tilt movement of the camera on the platform 21.

The column 12 has a horizontally extending platform 30 located to one side of the column and disposed below the inner end stage 15 of the arm. A guideway 31 is mounted on the platform and a wheeled carriage 32 is constrained to run on the guideway to support the carriage for horizontal movement along the guideway. The carriage is formed with a vertically

extending slot 33 in which a pin 34 on the inner end stage 15 of the arm is constrained to slide so that as the arm tilts about the horizontal axis C, the pin will slide up and down the slot and at the same time the carriage 32 will move along the guideway. Rams may be provided for moving the carriage along the guideway and for moving the pin vertically up and down the slot to provide "motorised" movement of the camera in the two axes of movement, that is parallel to axis A-B and towards and away from axis A-B.

To determine the movement and thereby the position of the camera platform with respect to the origin or datum of the axis A-B at the base of the camera mounting, one linear transducer 35 is mounted on the platform 30 and is coupled to the carriage 32 to determine horizontal movement of the carriage, a second linear transducer 36 is mounted vertically on the carriage to determine movement of the pin and a third transducer 37 is mounted on the base to determine rotation of the pedestal about the vertical axis A-B with respect to the base.

The pin on the arm provides a control point, movement of which in the horizontal and vertical directions will be proportional to the corresponding movements of the camera platform in horizontal and vertical directions. The constant of proportionality will be the number of moving stages "N" of the arm between the axis C and the platform 30.

Let m= the horizontal co-ordinate of the control point in the plane of the arm;

n= the vertical co-ordinate of the control point in the plane of the arm; and

θ= the angle of rotation of the arm about the vertical axis A-B.

Then the co-ordinates of the camera platform position relative to an origin on the vertical axis A-B will be as follows :

$$N.m.\cos.\theta;\ N.m.\sin\theta;\ N.n.$$

The information relating to the camera platform position may be fed to monitoring equipment which merges a virtual reality background with a foreground as seen by the camera. Transducers are also provided on the camera pan and tilt mechanisms for determining pan and tilt movement of the camera. The virtual reality background image is moved in accordance with movement of the camera mounting and the camera pan and tilt mechanisms as the camera is moved in viewing the foreground so that the virtual reality background moves appropriately with the foreground.

Figure 2 shows an alternative arrangement in which one rotary transducer 38 measures the angle α of the arm 10 to the horizontal and a second, linear transducer 39 measures the extension of one section of the arm with respect to another. This extension is proportional to the extension of the entire telescopic arm, the constant of proportionality being the number of stages of the arm between the axis C and the platform 30. The extension together with the angle α provides a set of co-ordinates for the camera position in a plane containing the arm and axis A-B. A third rotary transducer is placed on the axis A-B for measuring θ, the angle of orientation of the arm about the vertical axis.

The co-ordinates of the camera platform position are then defined as follows :

$(Nx+y) \cos \alpha \cos \theta;$
$(Nx+y) \cos \alpha \sin \theta;$
$(Nx+y) \sin \alpha.$

Figures 3 and 4 show an application of the invention to the balanced camera mounting embodying a pantographic arm as described and illustrated in our UK Patent Publication No. 2163720. The camera mounting comprises a base 50 mounted for rotation about a vertical axis indicated at A-B. A counter-balanced pantographic mechanism 51 is mounted on the base comprising an upwardly extending first parallelogram linkage 52 pivotally mounted about horizontal axes on the base and a second parallelogram linkage 53 connected by a common link 54 to the upper end of the first linkage at one end and having a camera support platform 55 at its other end. A counter-balancing mechanism indicated at 56 is connected to the parallelogram linkages and has a control point P constrained to move horizontally and vertically in proportion to the movement of the platform 55. Transducers determine the horizontal and vertical extent of movement of the control point P in a similar manner to the arrangement of Figure 1.

Movement of the control point P in the horizontal and vertical directions is proportional to the movement in the directions in the plane of the arm of the camera platform. The constant of proportionality "k" is related to the length of the sections of the linkages of the arm.

Two linear transducers measure the horizontal and

vertical or cartesian co-ordinates "m" and "n" of the point P relative to an origin on vertical axis A-B. A third rotary transducer is placed on axis A-B to measure θ, the angle of orientation of the arm about the vertical axis. The co-ordinates of the camera position are then as follows :

$$K.m.\cos\theta;$$
$$K.m.\sin\theta;$$
$$K.n.$$

Figure 4 shows a further arrangement to Figure 3 with an alternative arrangement of the transducers for determining the movement of the arm. Two rotary transducers are placed at the hinge points of the arm (as shown). Transducer 61 monitors the angle β which arm section 52 makes with the vertical. Transducer 62 monitors the angle α which arm section 52 makes with arm section 53. A third rotary transducer 63 is placed on the axis A-B to measure θ, the angle of orientation of the arm from a datum on the base.

The three angles α, β and θ can be used to find the co-ordinates of the position of the camera platform which are as follows :

$$[(L_1 \sin\beta + L_2 \sin(\beta+\alpha)].\mathrm{Cos}\,\theta;$$

$$[(L_1 \sin\beta + L_2 \sin(\beta+\alpha)].\mathrm{Sin}\,\theta;$$

$$L_1 \mathrm{Cos}\beta + L_2 \mathrm{Cos}\,(\beta+\alpha)$$